Citation:

Sherwood NE, Jeffery RW, French SA,Hannan PJ and Murray DM. Predictors of weight gain in the Pound of Prevention study. *Int J Obes Relat Metab Disord*. 2000; 395-403.

PubMed ID: 10805494

Study Design:

Prospective study

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

- To identify the diet and exercise behaviors that predict or accompany weight change over time
  - Are current levels of dietary intake and physical activity predictive of future body weight change over time?
  - Are current levels of dietary intake and physical activity associated cross-sectionally with body weight?
  - Are changes in levels of dietary intake and physical activity associated with changes in body weight over time?
  - Which components of dietary intake are most strongly associated with body weight and body weight changes over time?
  - Are varying intensities of physical activity differentially associated with body weight and body weight changes over time?

Inclusion Criteria:

- Within Pound of Prevention study/intervention
- Adults, between 20-45 years at enrollment
- Those who completed baseline and at least one other annual follow-up.

Exclusion Criteria:

Presence of major chronic disease.

Description of Study Protocol:

Recruitment

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- Direct mailings to university employee groups
- Newspaper advertisements
- Radio public service announcements
- In person at the Special Supplemental Nutrition Program for Women, Infants and Children (WIC).

Design

Cross-sectional, prospective correlational study within a randomized control trial.

Dietary Intake/Dietary Assessment Methodology

- Block Food -Frequency Questionnaire (FFQ)
    - Estimated total energy intake per day, percentage energy from fat and percentage energy from alcohol
- Kristal Low Fat Eating Behavior Scale
    - Cronbach alpha=0.84
    - Estimated frequency of engaging in behaviors related to lowering dietary fat intake.

Blinding Used

Not mentioned in study.

Intervention

Not applicable to current study.

Statistical Analysis

- Chi-square and T-tests used to compare participants who completed at least two of the four study assessment visits and participants who completed only the baseline assessment
- Random coefficient models to examine whether habitual diet and/or exercise patterns are predictive of future weight gain
- Better protect the nominal Type I error rate in the presence of heterogeneity among member specific slopes than the more familiar repeated measures ANOVA
- Regression effects decomposed into between and within subject domains
    - Average value across four assessment points-examination of cross sectional relationship
    - Deviation from that average at each assessment point-examination of prospective relationship
- Interactions with time were computed for both average and deviation scores
- Four components of dietary intake
    - Total kcal intake
    - Percent kcal intake from fat
    - Total Kristal score
    - Percent kcal intake from alcohol
- Four components of physical activity
    - High intensity physical activity
    - Moderate intensity physical activity
    - Group sports
    - Job activity
- Significance level of .012
    - If overall significance level not less than 0.0125, interaction terms removed from

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model and analysis was rerun to allow reduced models to test overall significance of main effects or interactions with time
- Separate analysis for males and females.

ANCOVA

- Compare participants who gained and participants lost over the three-year period (weight gainers gained more than five pounds, weight losers lost more than five pounds) on baseline values of dietary intake and physical activity
- Compare participants who gained and participants lost over the three-year period (weight gainers gained more than five pounds, weight losers lost more than five pounds) on amount and direction of change for each dietary intake and physical activity variable.

Data Collection Summary:

Timing of Measurements

Baseline and annually for the next three years

Dependent Variables

- Weight and height measured
- BMI calculated based on weight and height measurements.

Independent Variables

- Diet
    - Block FFQ
        - Estimated total energy intake per day, percentage energy from fat and percentage energy from alcohol
    - Kristal Low Fat Eating Behavior Scale
        - Cronbach alpha=0.84
        - Estimated frequency of engaging in behaviors related to lowering dietary fat intake
- Exercise
    - Physical Activity History
        - Estimated frequency per week of each category of physical activity
            - High intensity
            - Moderate intensity
            - Group and racquet sports
            - Occupational activity.

Control Variables

Control variables/Covariates for random coefficient models

- Time
- Age
    - Self-reported (along with other demographics not used as control variables or covariates)
- Smoking status
    - Current smoking status self reported at baseline and at second annual assessment (No

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significant change over time, so baseline measures used)
- Treatment group
  - Randomized
  - Treatment by time interaction.

Control variables/Covariates for ANCOVA

- Age
- Smoking status
- Treatment group
- Baseline body weight
- Baseline value on respective dependent variable.

Description of Actual Data Sample:

- *Initial N:* N=1,120
- *Attrition (final N):* N=1,044; Difference in participants who completed study vs. those who dropped out in terms of weight:
  - Female
    - Participants included in analysis weighed less (P<0.001), were younger (P<0.003) and reported higher income levels (P<0.001) compared to drop outs
  - Males
    - Participants included in analysis weighed less (P<0.038), had completed more schooling (P<0.001) and reported lower total energy intake (P<0.017)
  - Gender:
    - Female=826
    - Male=218
- *Age:*
  - Mean age female=35.1 (6.4) years
  - Mean age male=35.3 (6.0) years
- *Ethnicity:* "Predominantly White"
- *Other relevant demographics:* Mean Dietary Intake energy intake from alcohol (percent) at baseline:
  - Gender:
    - Females 2.4 (4.2)
    - Males 3.4 (4.4)
  - Education:
    - High School or less
      - Females 14.3%
      - Males 4.6%
    - Some college/vocational training
      - Females 40.1%
      - Males 24.3%
    - College graduate
      - Females 31.1%
      - Males 36.2%
    - Graduate/professional education
      - Females 14.5%
      - Males 34.9%

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- Marital status
  - Married
    - Females 45.6%
    - Males 62.8%
  - Divorced/separated/widowed
    - Females 18.8%
    - Males 7.8%
  - Never married
    - Females 35.6%
    - Males 29.4%
  - Employed
    - Females 82.6%
    - Males 97.2%
  - Job category
    - Professional
      - Females 33.2%
      - Male 58.3%
    - Clerical/sales
      - Females 33.3%
      - Males 17.0%
    - Blue collar
      - Females 6.8%
      - Males 14.7%
    - Other
      - Females 9.3%
      - Males 7.3%
- *Anthropometrics:*
  - Body weight (kg)
    - Females 72.3 (16.1)
    - Males 89.1 (15.9)
  - BMI (kg/m^2)
    - Females 26.8 (6.0)
    - Males 28.0 (4.7)
- *Location:* United States (Minnesota).

Summary of Results:

Key Findings

- Among both men and women, the most consistent results were the positive association between dietary fat intake and weight gain and an inverse association between frequency of physical activity and weight gain
- Individuals who weighed more both ate more and exercised less than those who weighed less
- Individuals who increased their physical activity level and decreased their food intake over time were protected from weight gain compared to those who did not; frequency of high-intensity physical activity was particularly important for both men and women
- Women who consistently engaged in higher levels of moderate physical activity gained weight at a slower rate compared to women who were less active
- Over three years of observation, the average of observation, the average weight gain of the

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study group was between 1.36 and 1.81kg over that same time period, study participants reported reducing energy intake, reducing fat intake, reducing physical activity and increasing alcohol intake
- A consistent relationship between total energy intake and body weight in women was also observed
- Mean changes in weight and percentage energy from alcohol over three-year period
    - Female (N=759)
        - +1.76 (6.7) kg body weight
        - +0.30 (3.7)% energy from alcohol
    - Males (N=198)
        - +1.69 (5.4) kg body weight
        - +0.88 (4.0)% energy from alcohol
- Changes in body weight, total energy intake, fat intake, and alcohol intake were significantly different from zero ($P<0.05$) for both men and women.

Multivariate cross-sectional and prospective associations between weight and percentage energy from alcohol

- No significant associations were noted in males
- A significant ($P=0.003$) inverse association in body weight and percentage energy from alcohol was noted in the cross sectional analysis of females; no significant finding was noted in the prospective analysis in females.

Author Conclusion:

The overall results indicate that both cross-sectionally and prospectively, the determinants of weight and weight change are multifactorial. Attention to exercise, fat intake, and total energy intake all appear important for successful long-term control of body weight.

Reviewer Comments:

- *Discrepancy in female and male demographics and other variables might be based on recruitment measures utilized and large difference in sample sizes of these genders*
- *Exclusion of any major chronic diseases may limit generalizability of this study's findings*
- *Limited measures of alcohol consumption (only FFQ used).*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes

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3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions

1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	No
3.	**Were study groups comparable?**	N/A
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	N/A
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A

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3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	???
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	???
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	No
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	Yes
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	Yes
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A

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6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	No
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes

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10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes

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